

Asset Management: Identifying and Evaluating our Roadway System

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Table 1

Appendix A – G

I. “What do we have?”

Next year the South Carolina Department of Transportation (SCDOT) will celebrate 100 years of serving the citizens of South Carolina. Established in 1917, as the SC Highway Department, the now SCDOT had an original budget of \$113,556.71 with no roads and only a 5 man commission to begin the task of developing and improving the state’s road system. (Moore, The South Carolina Highway Department 1917-1987, pages 52-53). Today SCDOT is charged with building and maintaining roads and bridges as well as providing mass transit services to the citizens of South Carolina. In responding to the charge SCDOT, with 41,400+ miles of roadway and 8420 bridges, maintains the 4th largest state supported system the United States. (Hartgen, Fields, and Feigenbaum, 21st Annual Report on the Performance of State highway Systems (1984-2012)). SCDOT’s current budget of approximately \$1.62 billion isn’t the bargain of the 1917 budget but the task that those first 5 commissioners started has grown into the single most valuable asset that the state of South Carolina owns; A multi-billion dollar network of ways to transport goods, go to work, school, church or soccer matches, ways to get to medical attention, every aspect of life is touch by our transportation system.

Historically SCDOT ranks in the top 10 each year for highway conditions and cost-effectiveness as rated by the Reason Foundation. (Hartgen, Fields, and Feigenbaum, 21st Annual Report on the Performance of State highway Systems (1984-2012)). With billions of dollars invested and billions to be invested it makes sense to invest the public’s tax dollars as wisely as possible. Therefore, assessing

what we have or better yet what condition what we have is in can be vital to public safety and setting priorities.

I will focus on the maintenance responsibility of Roadway Inspection as outlined in SCDOT Engineering Directive Memorandum #8 (EDM #8). EDM #8 is a portion of the way SCDOT provides for the safety of the traveling public and keeps South Carolina's most expensive asset in working order. See Appendix A for a copy of Engineering Directive #8.

II. Current Operating Procedure – Engineering Directive #8

In March of 2011, a revision of EDM #8 was issued to better define the expectations for daytime and nighttime inspections on all state maintained routes. The daytime inspection parameters include:

1. Interstates shall be inspected monthly
2. Primary routes shall be inspected once every six months
3. Secondary routes shall be inspected once each year

The purpose of these inspections is to detect or identify deficiencies that could pose a hazard to motorists or pedestrian, thus creating a risk for the SCDOT.

These inspections should include:

1. Pavements (includes pavement markings)
2. Shoulders (includes sidewalk and other roadside appurtenances)
3. Signs (look for missing signs)
4. Vegetation (include dead trees or overhanging limbs)

5. Drainage (includes structures and ditches)

The nighttime inspection parameters and deficiencies to note include:

1. Each roadway mile, regardless of functional class should be inspected at night once each year.
2. Sign reflectivity and visibility
3. Pavement markings reflectivity and visibility

The direction given in EDM #8 outlines what inspections need to be performed and how often but allows for each individual field office to determine how to meet these objectives.

III. Identifying the Problem

The guidelines and objectives are established in EDM #8 by the Deputy Secretary of Engineering as described above. The piece of the puzzle, left up to each Resident Maintenance Engineer (RME), is to decide the most efficient process to perform the inspections. RMEs are faced with short staffs and heavy workloads. (RMEs are responsible for directing the maintenance efforts in each county). With the short budgets and heavy workloads, they are not afforded the opportunity to experiment or otherwise analyze every process or expectation that is under their responsibility. An example would be who should perform the inspections and how? Should these inspectors be of a certain skill set? How should their inspectors review as many miles as possible and still note a high percentage of the deficiencies? Time is money and money is tax payer dollars, so how can we inspect more for less?

Data Collection

Who is currently performing the inspections? – Field interviews were conducted within District 3 (Greenville, Oconee, Pickens, and Spartanburg) RMEs, Georgia DOT (GDOT) maintenance engineering, and North Carolina DOT (NCDOT) maintenance engineering. (See Appendices B-G). The interviews determined that there was no consistency from one state to another but more importantly for our exercise, no consistency from one county to another within our district. Some of the counties were enlisting foremen, others had designated geodetic technicians, and still others had a mix of foremen, geodetic technicians as well as some engineering staff included in their reviews. GDOT have district level engineering staff that perform inspections and NCDOT outsources their inspections to consulting engineering firms.

SCDOT District 3 performed these inspections using foremen who are charged with making the repairs. Others were using additional geodetic technicians to perform these inspections on a part time basis when other tasks and responsibilities would allow. Neither option was ideal since many times the foremen performing the inspections would also be responsible for making the noted repairs. This caused a conflict of interest since work-loads for these foremen are already exceeding their current resources. For the geodetic technicians, they do prove to be an outside more objective set of eyes but more often than not these inspections are performed as a secondary duty and did not allow for the efficiency of repetitive inspection.

In addition to the question of “who,” the question of “how” needed to be addressed as well. In District 3 most counties were performing daytime inspections during their normal working hours. This took personnel away from their other day to day duties, in turn delaying their regular tasks. The nighttime inspections were performed by personnel working overtime in the evenings but for only a few hours a night since this was in addition to their normal daily work schedule.

Inspectors were not as efficient since they were not performing these inspections on a repetitive basis and since they were working beyond their 40 hour work week, it was move costly for SCDOT.

IV. Process Improvement – “Where Can We Go?”

Once the areas where efficiency could possibly be improved were identified, developing the “how” to improve those areas became the next hurdle. The first step was to identify what internal restrictions would limit affecting the areas of inefficiency.

Personnel resources are always stretched thin and even though reconfiguring the way we perform inspections will take dedicated staff time, the hope is the experiment of this process improvement, will over time reduce the number of person hours (PHrs) necessary to complete the task of EDM #8.

The second challenge would be improving the physical efficiency of performing the inspections in the field. By taking information gathered through interview and past history we would develop an initial protocol for field application. This process improvement would have to be made under the parameters that were within the control of the district. This would mean taking available resources and repurposing them would be critical to making change possible within the execution of EDM #8.

What resources are available?

In District 3 we took a four-man team and created a District 3 Inspection Team (DIT). These four employees were responsible for actually going into the field and performing the tasks of daytime and nighttime inspections. A portion of their duties already included inspections so they were

experienced and needed a minimal amount of instruction on EDM #8 inspections. They were also beneficial in identifying areas that work best or improved their ability to complete these inspections in a timely manner.

Three vehicles, that met the requirements outlines in EDM #8, were provided to this team for inspection use. Obtaining the 3 vehicles also allowed for inspectors to perform inspections in 3 separate regions at the same time.

Miscellaneous hand tools (hedge trimmer, sprayer, loppers, and shovel) were provided as well. These are used to help the overall efficiency of maintenance in general as the inspectors are charged with clearing deficiencies that require a minimal amount of attention.

Applying the resources

Once we acquired a four-man team, the vehicles and miscellaneous other items, tackling the “how” to apply these resources was next. In interviews and reviews of the counties original plans it was discovered that dividing each county into regions, either by geographical area or functional class of roadway, seemed to be a productive approach. Each county in District 3 (Greenville, Oconee, Pickens and Spartanburg) was divided into color coordinated regions. An example would be that the Northwest corner of each county was our “Blue Region”; the Southeastern corner would be the “Yellow Region”. The large more urban counties (Greenville and Spartanburg), were divided into 6 Regions where the smaller counties (Oconee and Pickens) were divided into 6 and 5 Regions respectively. Oconee was divided into 5 geographical regions and 1 “region” that included only primary routes. Pickens was divided into 4 geographical regions with an additional “region” that included all of their primary routes.

These Regions were established from several reasons. First, it allowed the DIT to divide and conquer. Each inspector would have a given area or “region” to focus on until that region was completed. Second, it made the inspectors more efficient since they would be able to reduce their driving time by focusing on a smaller section of the county. Third, it built the confidence of the RMEs that their county would not be overlooked. By completing portions (regions) of each county, throughout the process we were able to report them and show them the progress.

How much and how long?

In mid-August the above four-man team was and tasked with improving the process of daytime and nighttime inspection. In late August, this team assumed the responsibilities of inspecting all of District 3 roadways. This started with the take-over of the daytime and night time inspections that the counties had not completed. From January to the end of July the counties completed 88% of their daytime inspection and only 41% of their nighttime inspections. The counties accomplished these inspections at a rate of 3.26 miles per person hour (PH) for daytime and 3.04 miles per PH for nighttime inspections respectively. The District Inspection Team (DIT) completed the remaining 12% of daytime inspections and 59% of the nighttime inspections. The DIT accomplished these inspections at a rate of 6.16 miles per PH for daytime and 6.16 miles per PH for nighttime as well. (See Table – 1)

In addition the counties averaged just 1 deficiency noted every 34 miles on daytime inspections and 1 for every 31 miles on nighttime. In contrast the DIT averaged 1 deficiency every 14 miles on daytime inspections and 1 deficiency every 19 miles. (A deficiency is defined as any item or defect that could pose a hazard to motorists or pedestrians, thus creating a risk for the Department.) (See Table – 1)

The 2015 inspections totaled 16,433 miles of daytime and 4433 miles of nighttime. (The 20,000 mile parameter is determined from historical data. The 20,000 miles is greater than the actual road mileage due to some routes being reviewed more than the minimum required by EDM #8)

In order for the counties to account for that mileage it would take 5041.7 person hours to accomplish daytime and 1459.3 person hours to accomplish the nighttime. This equates to a total of 672+ person days for daytime inspections and 195+ person days for nighttime inspections; making a total of 866+ person days. We generally estimate that each full time employee (FTE) has 220 working days; so 866 working days would translate into 3.9 or approximately 4 full time employees.

In order for the District Inspection Team to accomplish the same mileage it would take 2668.6 person hours to accomplish daytime and 719.4 person hours to accomplish nighttime. This equates to 355+ person days for daytime inspections and 96+ person days for nighttime inspections; making a total of 451+ person days. Using the estimate of 220 person days per full time employee; 451 person days would translate into just over 2 (2.05) full time employees. (See Table – 1)

V. What Did We Learn? (Daytime and Nighttime Inspection Improvements)

The newly formed DIT worked for 4 months to collect data (perform inspections) and refined the process of daytime and nighttime inspection in District 3. The improvements that were identified and that led to a more efficient process are as follows:

- Centralizing the inspections to a four man teams will allow for daytime and nighttime inspections to be completed in approximately 6 months. (The previous way of performing inspections would have taken a 4 man team approximately 12 months).

- Using the same inspectors allows for a more consistent inspection across the entire district and reduces the “conflict of interest” that results when using county foreman. The DIT almost doubled the speed at which the inspections were previous performed but still, on average, noted more deficiencies per mile previous inspections.
- Dividing the counties into Regions allowed for better organization and scheduling of inspections. An example of improved efficiency would be: If an inspector was only schedule for a half a day of work (AL/SL/meeting) they could perform inspections in a region close to the office to maximize inspection time during a short day.

VI. Conclusion

Identifying items that could be a potential hazard to the traveling public is definitely a priority for SCDOT. Doing it in a timely and efficient manner is a necessity; especially when budgets are short and our system is quickly aging. The data that the DIT collected proves that when performed by a centralized team full time, the process of completing EDM #8, is more efficient and productive. The centralization of EDM #8 inspections will allow for district 3 to:

- More efficiently identify those areas of concern
- Provide for a more consistent review across the district
- Develop more focused inspectors and reduce the missed deficiencies
- Provide direct feedback to Resident Maintenance Engineers
- Monitor inspection progress through-out the year and adjust resources as needed
- Expand to other inspections

District 3 has completed the centralization of EDM #8 inspections. The DIT is currently handling all of these inspections and has been tasked with performing the same process for other maintenance inspections as well. As of January 1st of this year the DIT will handle all inspections

as required by or for, EDM #8, EDM #42, all culvert and all mechanically stabilized earth (MSE) walls in Greenville, Oconee, Pickens and Spartanburg counties. The addition of EDM #42, culvert and MSE wall inspections to the DIT responsibilities will further increase the districts efficiency and maintain the DIT as a full time unit. This will assist SCDOT in “maintaining the roads and bridges” in South Carolina and provide all the citizens and visitors with a safer journey in all of their travels within our state.

Table - 1
District 3 District Inspection Team vs County Inspections

	Inspection Hours	Miles Inspected	% Completed	Miles Inspected/Hour	Def. Noted	Miles/Def Noted	PHrs to Accomplish Annual Insp	Person Days	FTEs Required
DIT Daytime	308.68	1900.84	11.57%	6.16	134	14.19	2668.6	355.8	47.4
Daytime County	4458.52	14532.51	88.43%	3.26	428	33.95	5041.7	672.2	89.6
	4767.20	16433.35							
DI Team Nighttime	425.19	2620.25	59.11%	6.16	136	19.27	719.4	95.9	12.8
Nighttime County	596.78	1812.94	40.89%	3.04	58	31.26	1459.3	194.6	25.9
	1021.97	4433.19							

All above data was pulled from the SCDOT Highway Maintenance Management System (HMMS)

Appendix A

South Carolina Department of Transportation **Engineering Directive Memorandum**

Number: 8

Primary Department: Maintenance

Referrals: S.C. Code of Law 57-3-110

Subject: Road Inspections

Daytime Inspections

All roads on the state highway system shall be inspected during daylight hours according to the following schedule:

- Interstates – monthly
- Primary Routes – once every six months
- Secondary Routes – once each year

The purpose of these inspections is to detect deficiencies that could pose a hazard to motorists or pedestrians, thus creating a risk for the Department. These inspections should be entered into the Highway Maintenance Management System (HMMS) by using the “Inspections” work activity and the “Roadway/Drainage” work description. Discrepancies should be entered into the work request module using “SCDOT Inspector” as the type of requestor.

The following are examples of the assets and roadside appurtenances that should be inspected:

- Pavements (includes pavement markings)
- Shoulders (includes sidewalk and other roadside appurtenances)
- Barriers (includes guardrails, attenuators, barrier walls, and cable barrier)
- Signs (look for missing signs)
- Vegetation (includes dead trees or overhanging limbs)
- Drainage (includes structures and ditches)

In accordance with the above, each resident maintenance engineer (RME) will review all noted deficiencies and schedule the necessary work, giving priority to all safety-related items.

Nighttime Inspections

Night inspections are primarily designed to ensure that pavement markings and roadway signs are visible, have proper reflectorization, and meet standards set forth in the Manual on Uniform Traffic Control Devices (MUTCD). All roads on the state highway system shall be inspected at night once each calendar year. These inspections should be entered into HMMS by using the "Inspections" work activity and the "Nighttime" work description. Discrepancies should be entered into the work request module in a similar fashion as day inspections.

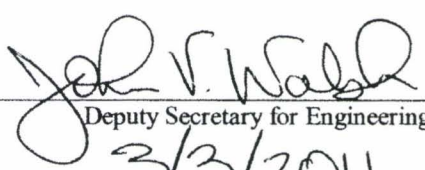
Inspections should be conducted in accordance with the following guidelines:

- The inspections should be conducted at normal operating speeds.
- The inspections should be conducted using low beam headlights.
- The inspections should be conducted using a 2005 model year or newer full-size pickup.
- Signs should be viewed at the typical viewing distance for that sign.
- Signs need to be replaced if not legible to the inspector.

In accordance with the above, each RME will make a list of signs and markings that need attention and schedule the needed repairs or replacement on a priority basis.

The resident maintenance engineer will certify in writing to the district engineering administrator by January 1 of each year that all system roads within his/her county have been inspected in accordance with this directive. The district engineering administrator shall then notify the director of maintenance no later than January 10, with the deputy secretary for engineering being notified by January 15, that the inspections have been completed.

Approved by: _____


Deputy Secretary for Engineering

Effective Date: _____

3/3/2011

Appendix B

Municipal/County Questionnaire:

City or County: Greenville County SCDOT

Michael Biege, SCDOT Contracts Engineer

What is the size of your system? 1400+ miles of Interstate, Primary and secondary routes

Do you have a formal roadway assessment inspection plan in-place? Yes. Foremen have defined areas that they inspect for both daytime and nighttime inspections.

If so, how long have you had it in place? Since first inception of EDM#8.

Do you day and night inspections? Yes are required by EDM #8

Who do you have perform the inspections? Foreman and sometimes geodetic or engineering staff.

Is it part of their normal duties or does they fall on them to perform on overtime? These inspections are in addition to their normal duties and are many times performed on overtime.

Do you know your rate of inspection? (Miles/PH) No. (DIT calculated county averages at 3.26 daytime and 3.04 nighttime respectively)

What do you expect your inspectors to note or identify? All problems that pose a safety issue to the traveling public

Do you receive many claims? Yes

Have you had any lawsuits for defects? Yes

Appendix C

Municipal/County Questionnaire:

City or County: Oconee County SCDOT

James Burns, Oconee Maintenance Contracts Office

What is the size of your system? 800+ miles of interstate, primary and secondary routes

Do you have a formal roadway assessment inspection plan in-place? Yes

If so, how long have you had it in place? It has been developed for several years since EDM #8 was first enacted.

Do you day and night inspections? Yes

Who do you have perform the inspections? Our foreman and other trades specialists

Is it part of their normal duties or does they fall on them to perform on overtime? Sometimes nighttime inspections are performed on overtime.

Do you know your rate of inspection? (Miles/PH) No. (DIT calculated county averages at 3.26 daytime and 3.04 nighttime respectively)

What do you expect your inspectors to note or identify? They are expected to make note of all deficiencies that affect the roadway system in Oconee County.

Do you receive many claims? Yes, but not very many.

Have you had any lawsuits for defects? There have been very few over the years.

Appendix D

Municipal/County Questionnaire:

City or County: Pickens County SCDOT

Steven Henderson, Resident Maintenance Engineer

What is the size of your system? 700+ miles of primary and secondary routes

Do you have a formal roadway assessment inspection plan in-place? Yes we have our county divided into regions and follow EDM #8

If so, how long have you had it in place? Our current plan has been in place for 3 or more years

Do you day and night inspections? Yes

Who do you have perform the inspections? Our foreman inspect during the day. They perform nighttime inspections on overtime.

Is it part of their normal duties or does they fall on them to perform on overtime? It is considered part of their duties but does require overtime to complete nighttime inspections.

Do you know your rate of inspection? (Miles/PH) No. (DIT calculated county averages at 3.26 daytime and 3.04 nighttime respectively)

What do you expect your inspectors to note or identify? All deficiencies that require attention by our maintenance staff

Do you receive many claims? Yes, but very few

Have you had any lawsuits for defects? We have had a couple over the last few years.

Appendix E

Municipal/County Questionnaire:

City or County: Spartanburg County SCDOT

Charlie Wilbanks, SCDOT Contracts Engineer

What is the size of your system? 1300+ miles of interstate, Primary and secondary routes. We have the state's largest inventory of Interstate.

Do you have a formal roadway assessment inspection plan in-place? Yes is has varied over the years.

If so, how long have you had it in place? Our current method of inspection is to use a couple of our geodetic technicians to perform these inspections.

Do you day and night inspections? Yes as required by EDM #8

Who do you have perform the inspections? A couple of our geodetic techs in the contracts office perform the inspections.

Is it part of their normal duties or does they fall on them to perform on overtime? They also perform other inspections for our contracts office. These duties are not overtime duties.

Do you know your rate of inspection? (Miles/PH) No. (DIT calculated county averages at 3.26 daytime and 3.04 nightttime respectively)

What do you expect your inspectors to note or identify? Any issues that can be seen as a safety issue to the traveling public.

Do you receive many claims? Yes

Have you had any lawsuits for defects? Yes

Appendix F

Municipal/County Questionnaire:

City or County: D1 Region 3 GDOT

Steve Hayes, GDOT

What is the size of your system? Steve oversees 6 counties with 700 miles of primary and interstate routes.

Do you have a formal roadway assessment inspection plan in-place? Yes. Daytime and nighttime inspections are performed annually. (Daytime in the fall and Nighttime in the winter.)

If so, how long have you had it in place? The inspections take 4-6 weeks each.

Do you perform day and night inspections? Yes.

Who do you have perform the inspections? Steve does the inspections on his own.

Is it part of their normal duties or does they fall on them to perform on overtime? These are in addition to his day to day duties of overseeing 6 crews.

Do you know your rate of inspection? (Miles/PH) It depends on his daily interruptions, but he usually averages 40 miles a day.

What do you expect your inspectors to note or identify? Daytime – high low shoulders, drainage issues, sight distance, potholes, anything that can be a hazard to the traveling public or cause unnecessary wear and tear on the roadway.

Do you receive many claims? District safety officer handles claims but his office will receive and pass them along.

Comments:

* Pipes Inspection 50% per year.

* No guardrail inspections - the foreman are to note damages in weekly reviews.

Appendix G

Municipal/County Questionnaire:

City or County: Henderson County, NC

Roger Ayers, NCDOT

828-694-7971

What is the size of your system? 950 Miles

Do you have a formal roadway assessment inspection plan in-place? Yes. Our secondary routes are inspected annually, and our Interstate and Primary routes every 2 years.

If so, how long have you had it in place? Contract has been in place state wide for 2 years. They were doing them internally for years.

Do you perform day and night inspections? Yes. Contracted out daytime and night time is done by "sign department."

Who do you have perform the inspections? Contractor and sign department

Is it part of their normal duties or does they fall on them to perform on overtime? It was performed in house by the maintenance employees

Do you know your rate of inspection? (Miles/PH) He did not know.

What do you expect your inspectors to note or identify? Daytime inspectors check for high lo shoulder, culvert issues, drainage issues, sight distance problems, etc. (same as SCDOT). Night time inspections check for sign reflectivity and pavement markings.

Do you receive many claims? NA

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